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THE DIFFERENT CONSUMING OF PRIMARY ECO-ENERGIES AND THEIR DEGRADATION IN TERRITORIAL SYSTEMS

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Abstract: The territorial system is considered as an operational unit, and it defined as the territory associated to a community at different levels (macro-, mezzo- and micro-scale), functioning together, based on a project and having a common objective. The evaluation of primary eco-energies started from the idea there is a direct relationship between the way of using lands and the quantity of primary eco-energies. The highest values are considered those from the compact forested massifs, and the most reduced are those from the strongly urbanised areas and from natural areas excessively degraded. Consequently, this study aimed to demonstrate the hypothesis according to which the consumption of primary eco-energies is different, depending on the intensity of the anthropic process. The correlation analysis is carried on two samples, revealing the particularities existent at macro-scale (Romania) and micro-scale (the territorial system Sărățel, Buzău County). By overlapping the detailed map regarding the quantity of primary eco-energies and the map of the degree of anthropic process, elaborated by common kriging, there were obtained areas which spatially prove the existence of a reverse relation. The anthropic pressure in case of a territorial micro-system (Sărățel) suffered modifications, but the processes of consumption and degradation of primary eco-energies were continuous and even accelerated, due to the fragility of natural components. The empirical research which was unfold may constitute an alternative to the sometimes very sophisticated studies which measure complex processes, as those of consumption and degradation of primary eco-energies. This may offer arguments for the defining of some territorial policies which could limit the negative effects of extensive urbanisation and ensure caution in direct interventions upon natural and social-economical structures of some fragile territorial systems.

Keywords: territorial system, anthropic process, primary eco-energies, common kriging.

1. INTRODUCTION

The dynamic of territorial systems is the result of the permanent interaction between energetic, endogenous and exogenous flows, which, by their intensity, structure and effects modify their functionality and appearance. The changing processes, which take place in the direction of the complexity increase, by the concentration of population and economic activities in the territory, are big energy consumers. This energy is used in the conversion processes under other forms, in mass redistributions, in structural constructions more or less complicated, but efficient for achieving the fixed objectives. A large part of the energies used in the dynamic of territorial systems have got as a source primary eco-energies, *representing those energies which were constituted naturally, before the start of the anthropic process* (Ianoş, 2000). The genesis of primary eco-energies is continuous, but much diminished by their consuming and by the reducing of the capacity of the producing area for such energies. The consumption of primary energies, to which the consumption of secondary energies is added, is responsible of the increase of complexity within territorial systems.

In the present article, it is demonstrated that the relationship between the anthropic process (with its extreme form, urbanisation) and the quantity of primary eco-energies left in the territorial system is a reversed and exponential relationship, at macro-scale level. The anthropic process was continuous after the

apparition of human society, but urbanisation emphasized it, determining the fundamental change of the relationship between energies' generation and the consumption of primary eco-energies. At micro-scale level, this inverse relationship is emphasized by the fact that besides the consumption of primary eco-energies by population and their activities, it obviously comes out the process of degradation of primary eco-energies by natural processes, too. In order to ensure a larger coherence to this approach, the territorial system was used as a reference unit.

2. THEORETICAL FRAMEWORK

Territorial systems represent functional structures, made of natural, social, economic, psychological components and supporting elements of the man's activity (the built space). Between these major components interdependence relationships are established, aiming to attain some common purposes established by human communities. As it is the case of the ecosystem concept, which is independent of scale (Pickett & Cadenasso, 2002), territorial system, as structure and dynamic, is present at all hierarchic levels. Consequently, territorial systems, by definition, are transscale constructions depending on the type and size of human communities, to which project space is associated. This project is defined by social-economic, cultural or wealth objectives, for the achieving of which the energies in such a system are functionally oriented. The dynamic of these systems is in tight connection to the concepts of primary and anthropic eco-energy. In other terms, territorial systems express in an empirical way what Gunderson and Holling defined by the term of „panarchy": a framework for the conceptualisation of coupled systems man-environment (Gotts, 2007).

Primary eco-energy designates the initial energy of a territorial system before the intervention of man as an aware factor in its structures. Anthropic intervention was not always unexpected and this could be evaluated by the permanent change of the way of using lands. The quantity of primary eco-energies was empirically evaluated by the correlation between its volume and the big categories of using lands. Thus, it is considered that the largest primary eco-energies are situated in massive sylvan spaces, where anthropic intervention was at the periphery, very punctual or along some penetration axes. The most reduced quantity of primary eco-energies is situated in strongly urbanized spaces, intensively exploited by surface mining (Braghină et al., 2010) or in natural spaces which were completely degraded, by the clearing out of the vegetal carpet and the soil. Between this maximum and minimum, the quantity of primary eco-energies varies, and it is correlated to the type of lands' use and with the intensity of anthropic interventions.

In such a theoretical framework, territorial systems may be conceived as thermo-dynamic and informational systems, optimally open, having an anti-entropic behaviour (Ianoş, 2004). This last characteristic underlines the fact that territorial systems permanently tend to maximize the inputs of energy, which they dissipate in order to maintain their structure, develop it and increase it in complexity (Botnariuc, 1999). A part of this energy is spent in metabolic processes and it is dissipated under the form of caloric energy, whereas another part is used for the organising which has as a purpose to maximize the inputs of energy so that a reduced percentage should be kept under the concentrated form of primary production, which is found in the environment goods (Vădineanu et al., 2004).

In the urbanisation process, natural systems become more and more anthropised, the concentration of population and economic activities determining a different consumption of resources, and implicitly of primary eco-energies. From this point of view, we could state that strongly anthropised territorial systems are, from the energetic point of view, parasite, being strictly dependent on the reserves of very concentrated primary eco-energy and on natural resources (Vădineanu, 1998). The increase of the quantity absorbed by anthropic systems is done by the increase of the complexity of channels of resources' absorption by human communities. By specific infrastructures and by the changes induced within territorial systems, social-economic activities prove their structuring character upon geographical space (Sârbu, 2006). Taking into account the coexistence of two targets, an aware target, defined by the higher and higher exigencies of human communities, and another target oriented towards reaching the natural balance, most part of primary and current eco-energies is used for the diversification of the internal structure (Fig. 1). Consequently, starting from the analysis of the structural diversity of a territorial system, the level of primary eco-energies and their renewing capacity can be appreciated. The theoretical basis of this approach is the process of attaching, re-attaching and detaching the anthropic mechanisms from/ to natural mechanisms, as the aim of the territorial system is to absorb an as large as possible quantity of mass, energy and information.

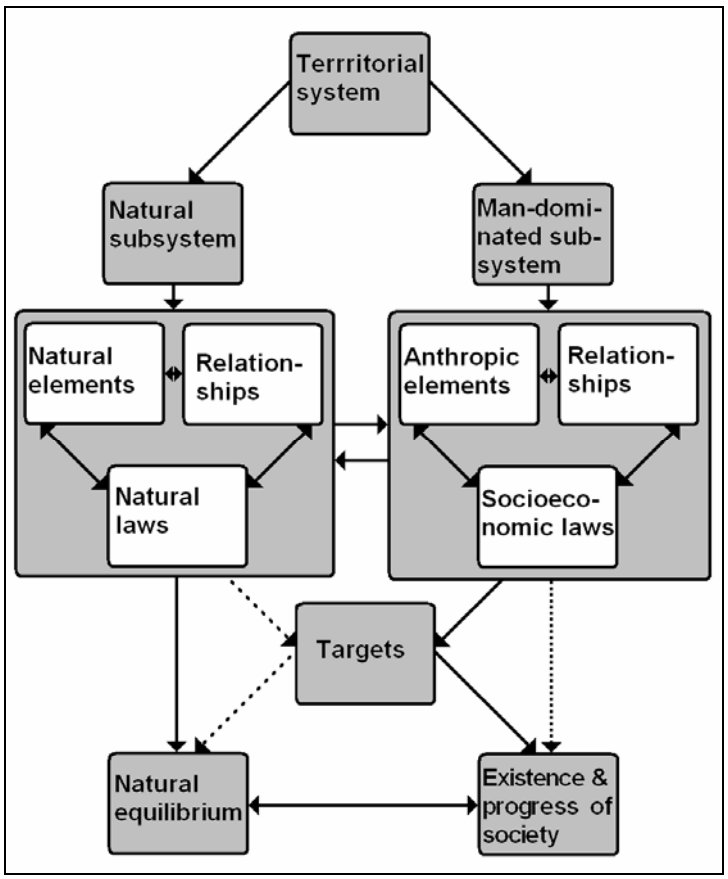


Figure 1. The territorial system (according to Ianoş, 2000, with modifications)

Their transfer is done between different hierarchical levels, approximated by trophic levels (Doxiadis, 1968), which include processes which are specific to the transition process from natural to highly anthropised territorial systems (Table 1). This succession of elementary and complex processes, associated to trophic levels, shows that under the influence of anthropic process, an energetic transfer takes place, from natural towards anthropised systems. The effect of the energetic transfer and of the mass re-localisation is found, on the one hand, in the intensity of the process of de-structuring the natural functionality and the erosion of biodiversity, and on the other hand, in the diversity of anthropic subsystems. This diversification is done by the coming out of new structural elements and the increase of functional complexity, once the urbanisation processes are accelerated. The permanent morphogenesis of territorial systems determines an increase of geo-diversity (Petrişor & Sârbu, 2010). The meaning given to geo-diversity has in view the geographical complexity of the landscape, conceived in a systemic sense (Bertrand, 1968).

From the systems' theory point of view, adaptive cycles characterized by four stages can be distinguished in the evolution of natural systems (Fig. 2): exploitation – r, structural consolidation – K, creative destruction – ω and restructuring or de-structuring – α, these stages being in tight connection with the dynamic of integrated and integrator systems, of superior rank (Holling & Gunderson, 2002). The main characteristic of the adaptive cycle is that a phase creates the premises for the next and, obviously, an increase in the first attracts a reorganising of the others (Holling, 2004

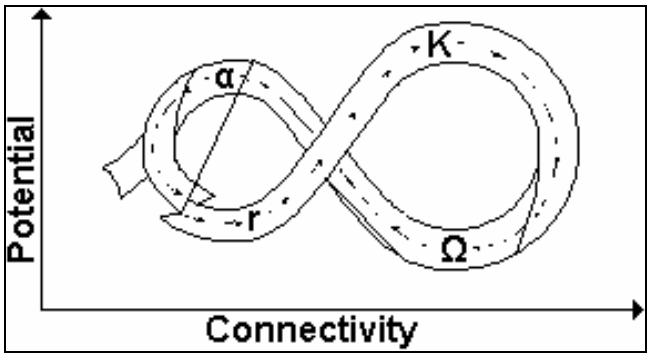


Figure 2. Adaptive cycles of the evolution of ecological systems (Holling & Gunderson, 2002)

In case of territorial systems strongly anthropised the phases are different, proving a succession, relatively similar, in accordance with the permanent increase of complexity.

Table 1. The correspondence between the trophic levels of natural systems and those from the strongly anthropised territorial systems

Trophic level	The existence in territorial systems	The existence in anthropised systems	Characteristic processes
Mineralotrophy	Yes	Very reduced, due to the replacement of some natural components or to their fragmentary apparition	The interaction of rocks with natural agents – erosion, decomposition, dissolution
Fitotrophy	Yes	Reduced for green areas, modified; urban ecosystems have got insignificant primary rough production; the energy is transferred from natural systems.	Plants, by photosynthesis process, transform minerals and carbon dioxide from the atmosphere into primary rough production; the energy is stored in chemical chains (approximately 2%) and dissipated by metabolic processes under the form of heat (approximately 98%).
Zootrophy	Yes	Very reduced, specific to built environment and urban green areas.	Primary consumers (herbivore organisms) take over primary rough production (approximately 40-85% from primary rough production) from primary producers. A large part is spent in metabolic processes and dissipated under caloric form, and a part is concentrated (approximately 10 times) and transmitted to the next trophic level, the process being restarted up to the level of peak consumers. At the same time with the energy, it is concentrated the mass, too, inclusively pollutant substances.
Technotrophy	No	Yes, visible in urban infrastructures (civil, industrial constructions, interurban telecommunication ways etc)	On the basis of the energy consumption from the natural systems (inclusively from fossil combustibles), processes of sedentariness, agriculture practice, industrialization, urbanization etc take place.
Noo-trophy	No	Yes, in a great measure concretised in knowledge, services, information, transmitted and established in informational structures.	Research, management, education, financing, considered as present processes involved in innovative development, of high performance.

In progressive anthropised phase, which characterises strongly anthropised territorial systems, the phenomena observed have got a spiral type cyclic dynamic (Fig. 3.)

If we analyse the history of a strongly anthropised territorial system as it is the town, we could notice the following succession of stages, starting with natural systems: (1) the coming out of rural settlements, by the concentration of population, due to the exploitation of some natural resources or to the development of some advantages given by the geographical position; (2) the increase of the degree of demographic and economic concentration is the basis of urban morphogenesis, centred upon the creative destruction of previous rural structures; (3) the phenomena of urban development correspond to those of maturity of towns; (4) internal dynamic and especially environment dynamic supposes processes of urban restructuring, contouring an adaptation phase to the new changes of environment. When the existent structure proves to be incompatible with the new urban social-economic processes, restructuring may know more radical forms, reaching de-structuring. In parallel, emergent structures appear and develop, and these will produce a new quality in urban environment and the result will be a re-optimisation of the urban insertion into environment. The extreme evolution, by de-structuring, may determine fundamental modifications and the apparition of new territorial systems. Within such an approach, the main idea was that territorial system keeps its identity, whereas its dynamic is mainly based on endogenous factors (Cumming &Collier, 2005). Exogenous factors only interfere when it is about major cleavages, needing reorganising processes or determining de-structuring.

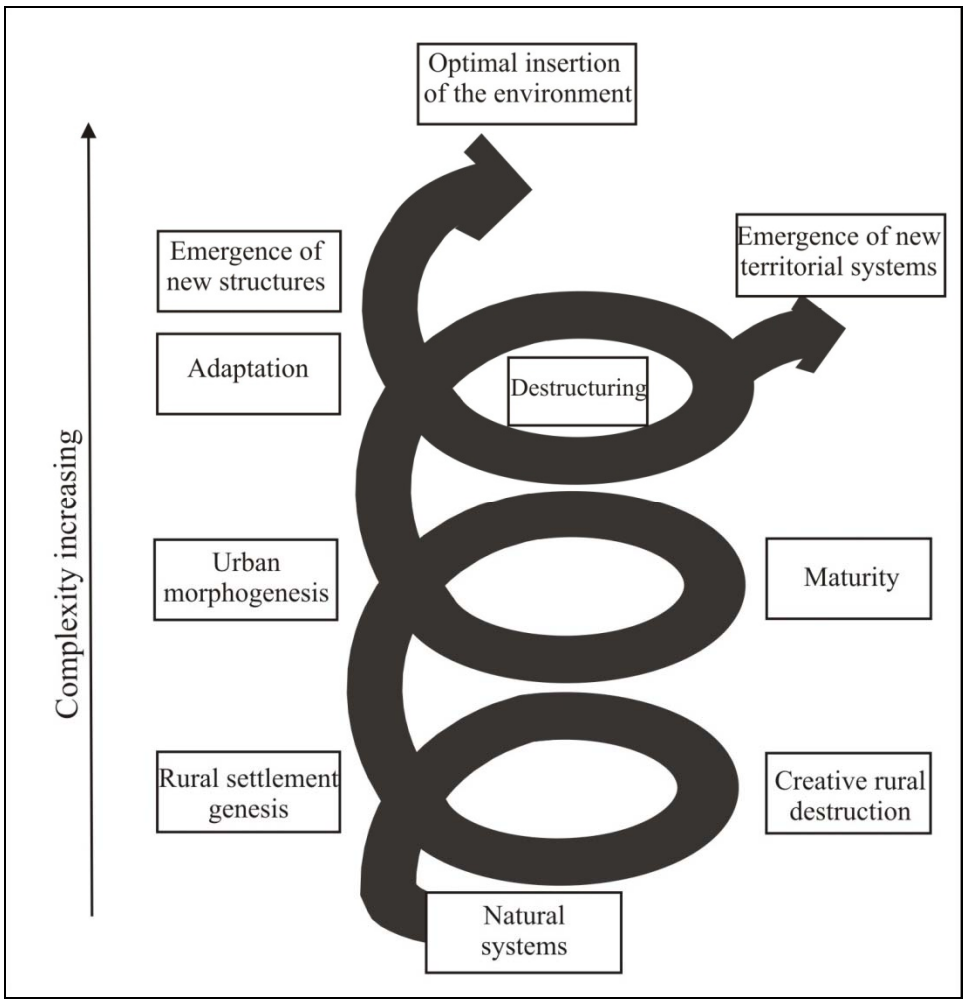


Figure 3. The spiral type cyclic dynamic of strongly anthropised territorial systems

The dominance of tendencies in the evolution of territorial systems is given by the increase of complexity, which appears in the form of a spiral. The question is whether the adapting process continues, by the consuming and degradation of primary eco-energies, isn't the spiral of the territorial systems oriented downwardly, leading to catastrophe (Bunce et al., 2009). The emergence of new territorial systems, in the conditions of the accelerated diminution of primary eco-energies may lead to the idea that, starting with a certain critical point, the spiral should not be oriented upside-down.

3. MATERIALS AND METHODS

This study starts from the hypothesis according to which intensely populated areas, with a high degree of anthropic process, are situated in regions with a low level of primary eco-energies, consumed along historical periods. Methodologically, a method of research based on using GIS and some techniques of geo-statistical analysis is proposed. Using these instruments, the purpose is both to try to identify the areas where modifications are more ample and more frequent, and the possible causes.

In analysing the processes of consuming and degradation of primary eco-energies in relation to those of urbanisation, the Geographic Information System (GIS) was conceived as a system of assisting the decisions on the basis of integration of data with a spatial reference in solving some problems (Cowen, 1988). Using this system regarded the relationship between territorial distribution of primary eco-energies and the urbanisation degree, having in view the concentration of population in towns.

At the basis of the present study there were two general aspects: (1) the evaluation at macro- and micro-scale of the quantities of primary eco-energy (by appreciating qualitatively the level of conservation in geo-systems), which allowed the elaboration of two maps with its spatial distribution on five categories (very low, low, average, high and very high) and (2) the spatial evaluation of anthropic pressure, by the degree of population concentration and of economic activities, which was done by the technique of common kriging (the values of the

degree of anthropic process were divided in five classes of intensity, too).

This study uses data regarding the division on main territorial-administrative units, counties, delivered by the Interdisciplinary Center for Advanced Studies on Territorial Dynamic within University of Bucharest and by the National Institute of Research-Development for Urbanism and Landscape Planning Urbanproiect – Bucharest. The database was filled in with the population of the county seats municipalities and the level of urbanisation per counties, calculated as the relationship between urban population and total population of the county. For the micro-scale analyses, the data were obtained from the communes' level, as well as from the level of the County Statistics Department Buzau and from the population censuses. The use of lands in the territorial system Sărățel was generalised according to C*ORINE Land Cover 2000* (Petrişor et al., 2010).

The analysis of these data was unfolded with the help of the programmes ArcView, version 3.3, ArcGIS, version 9.2 and of the following extensions, in terms of the specific of the main maps which were used. Therefore, the ***population map*** was made having as entrance data the population by counties, having as centres the county seats municipalities. With the help of the extension *X-Tools,* the polygonal surfaces obtained were reduced to their geometric centre (in case where, due to the polygon's configuration, it is outside the respective contour, the programme places it inside, automatically). The map was obtained using the interpolation of these centres by the *common kriging* technique, a method of spatial prediction which supposes that spatial distribution of a variable depends exclusively on the coordinates of the locations from which extrapolation starts, the result being the delimitation of some regions with population (1) very low, (2) low, (3) average, (4) high and (5) very high, represented with the help of darker and darker colours.

Similarly, the ***urbanisation map*** was done this way, starting from the allocation of the value of urbanisation degree of the county seat's centre, based on the fact that the county seat represents its urban centre. Similarly, the *common kriging* technique was used, obtaining regions with (1) very low, (2) low, (3) average, (4) high and (5) very high urbanisation degree, represented with the help of darker and darker colours. The two maps obtained overlapped the distribution of primary eco-energies at the level of national territory (Ianoş, 2000).

Using the same demarche, the study included a **micro-scale analysis**, taking as a sample the territorial system Sărățel from Buzău county, with its entire natural, human and social-economic load. The two maps representing the distribution of primary eco-energies and of population per villages, reconfirms the inversely proportional relation between the anthropic process and the quantity of primary eco-energies left in the present geo-systems. In other words, their consuming, accompanied by a degradation process, by transformation or by natural way, is the main responsible factor for the different quantity at the level of territorial systems.

4. RESULTS AND DISCUSSIONS

The results of the research carried on at macro-scale level are presented in two synthesis maps. One of these presents the distribution of population in relation with the distribution of primary eco-energies (Fig. 4). There can be noticed that the counties with the most numerous population are those which possess large urban centres. An exception can be noticed in case of the Capital, Bucharest city, which is by far the most anthropised territorial system in Romania and in which primary eco-energies are practically the most reduced. The interaction between natural components as a whole does not generate eco-energies, as it lacks some fundamental components, like vegetation and soil, which are extremely fragmentary. To all these, other components are added, like those represented by the relief, water and microclimate, which demonstrate the inexistence of some essential mechanisms of interaction, able to generate or preserve primary eco-energies.

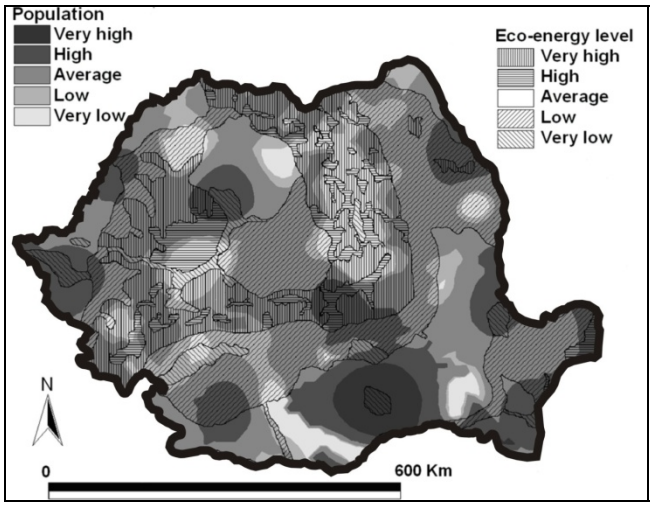


Figure 4. The spatial distribution of primary eco-energies (Ianoş, 2000) in relation with Romania's population

Similarly, we can notice that other very populated counties, too, reach reduced levels of

primary eco-energies: Galați, Constanța, Iaşi, Cluj, Timiş, Dolj. Per county, they are very reduced (the county-seats towns or other urban concentrations), but on the whole, as they hold large areas, less populated, they present high values of primary eco-energies, too, especially in mountainous areas (Cluj).

In opposition with this situation we can notice that less populated counties have got relatively high values of primary eco-energies, even if surface activities, of agricultural type, proved to be big consumers of this kind of energies. Thus, the highest values of primary eco-energies are met in the counties Caraş-Severin, Maramureş and even Hunedoara, even if, per county, especially in the areas with mining exploitations or depressionary areas, they present values close to national average or even below it (the exploitation areas of non-ferrous ores from Moldova Noua or coal exploitation Anina, Baia Mare, with the surrounding mining area, respectively the areas of coal exploitation from the Petroşani basin).

The distribution of the urbanisation degree in relation with the eco-energies map is presented in figure 5. This way, it is verified the hypothesis according to which extreme anthropic process almost finished primary eco-energies, by a very intense consuming.

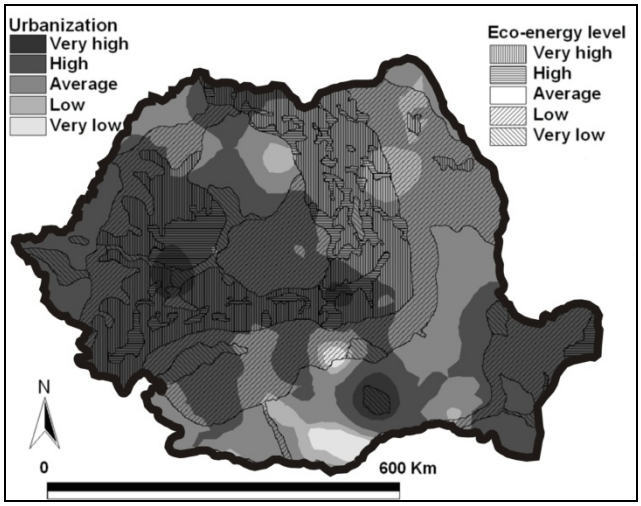


Figure 5. The spatial distribution of primary eco-energies (Ianoş, 2000) in relation with Romania's population from the towns

The method used emphasizes, by extrapolating the tendencies, the effects of large urban concentrations upon the consuming of primary eco-energies. The case of Bucharest, whose space overlaps the administrative unit with the same name, was analysed above. From the examination of the map, we can notice the following:

- the highest values of the urbanisation degree is present in three distinct areas: Bucharest, relatively punctual, Dobrogea and the area Galați-Brăila, much influenced by urban agglomerations, and central-western Transylvania, having two urbanisation nuclei given by urban concentrations centred upon Braşov and urban groups from the Mureş Valley and Turda – Cluj-Napoca.

- the urbanisation areas overlap very clearly areas with relatively homogenous values of primary eco-energies in the situation of Bucharest and Dobrogea.

- central-western Transylvania is characterised by a mosaic of spaces, with very different values of primary eco-energies, from the highest, in mountainous areas, to the lowest, in urban spaces.

- the rest of Romania is centred upon relatively low values of the urbanisation degree and high values of primary eco-energies.

The analysis done at micro-scale level validates the hypothesis of a tight connection between territorial distribution of primary eco-energies (Fig. 6A) and the level of the anthropic process measured by the population density and concentration (Fig. 6B). The analysed territorial system gathers an association of 26 villages (all of them under 1000 inhabitants) on a space (totally overlapping the basin of the river Sărățel), which numbers 187 square kilometres (Diaconu, 2005).

The main characteristic of this sample is the fragility of the natural components, which self-accentuates by the dynamic of relief and the influence of the tectonic, but especially by the anthropic process. The last mentioned process knew important variations along time, leading to the excessive consuming of primary eco-energies and to the occurrence of the premises for natural degradation. Having in view the anthropic process is directly proportional with demographic growth, we can appreciate that, at the level of the entire territorial system there was a maximum intensity of the anthropic process in 1956, when there were registered almost 12.000 inhabitants (Table 2) (Stoica, 2008).

Although the population followed an alarming ascendant trend, due to the process of industrialisation and to the demand of work power for the economy of Buzău, which is also a county-seat, the effect of economic activities determined a permanent growth of the degradation of primary eco-energies. These eco-energies' consuming, by the demographic increase and by connected activities, represented by agricultural activities, the expansion of surfaces occupied with natural meadow-lands and especially by animal breeding, reached a maximum in the years 1955-1985.

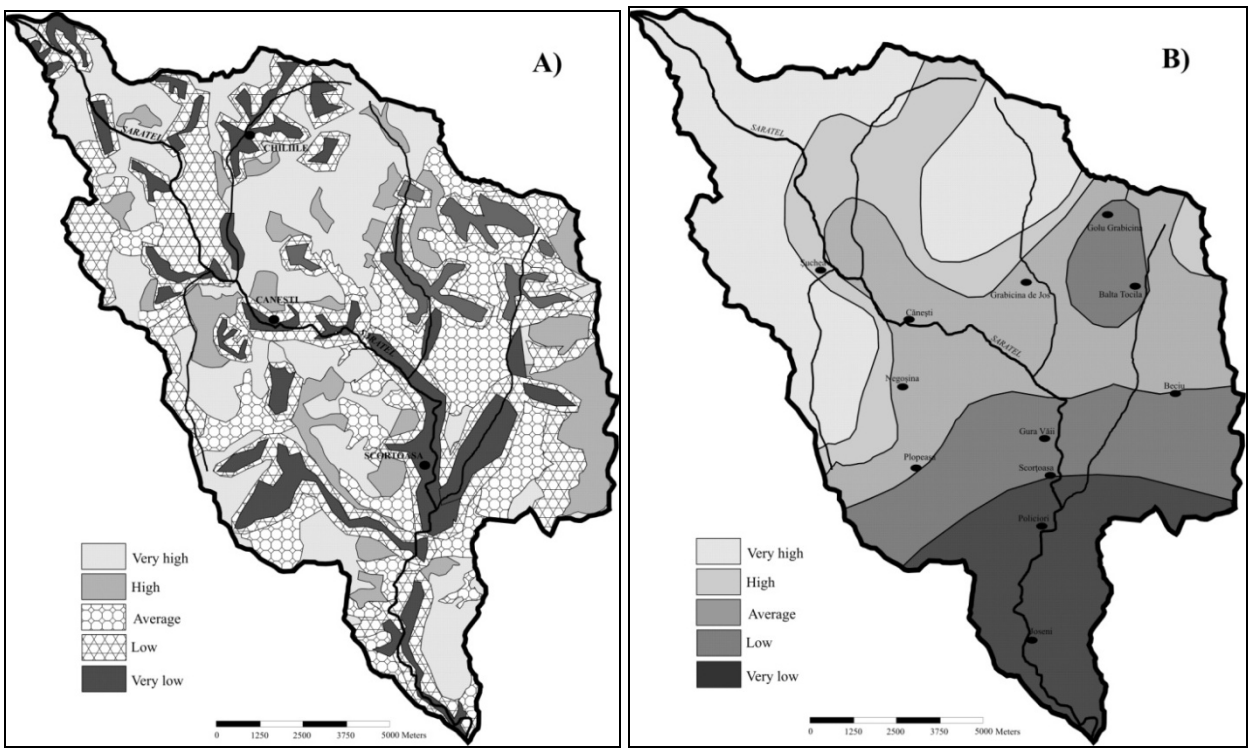
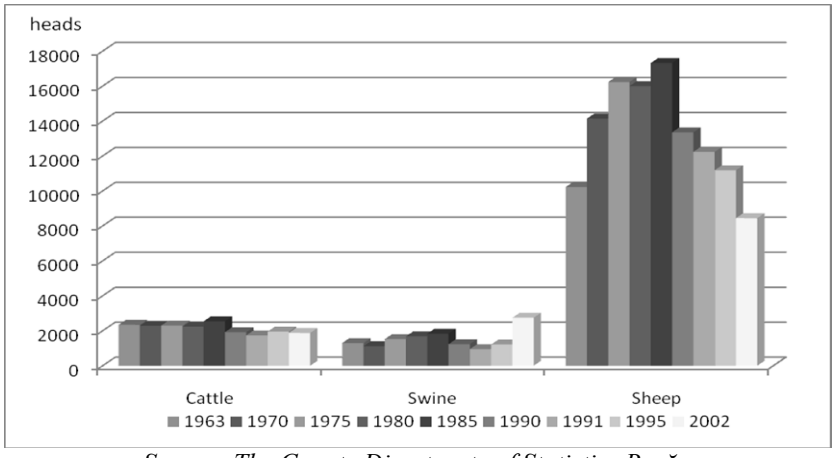


Figure 6. The spatial distribution of primary eco-energies (A) and of the anthropic process degree (B) in the territorial system Sărățel

Table 2. The dynamic of the inhabitants' number in the territorial system Sărățel.
(c) commune, (s) village belonging to other communes

	1890	**1912**	**1930**	**1956**	**1966**	**1977**	**1992**	**2002**	**2007**
Total	**6750**	**10184**	**10850**	**11744**	**10575**	**8822**	**6756**	**6374**	**5818**
Cănești (c)	1460	2048	2159	2119	1938	1465	1184	1091	975
Chiliile (c)	1260	1849	1874	2067	1792	1330	926	779	698
Scorțoasa (c)	3250	5189	5543	6132	5560	4826	3598	3433	3175
Joseni (s)	680	928	1054	1269	1110	1076	951	986	900
Scoroșești (s)	100	170	220	157	175	125	97	85	72

Source: Iorgulescu, 1892 (for the year 1890); The County Directorate of Statistics Buzău



Source: The County Directorate of Statistics Buzău
Figure 7. The dynamic of animal number on categories in the territorial system Sărățel (heads)

The dynamic of the inhabitants' number on categories reveals an important fluctuation in case of sheep (Fig.7). Their number increased in the interval 1963-1985 with over 70%, emphasizing, by excessive grazing, the unbalance of natural components. There followed the accentuation of linear erosion, the extension of surfaces affected by landslides and implicitly the decrease of the potential of eco-energies' production. Even if population and agriculture diminished their pressure a lot, after the year 1965, respectively 1985, anthropic degradation of primary eco-energies was mostly doubled by natural degradation. The fragile structure of natural components was enough to be affected by over-population, and subsequently the process of natural degradation self-extended.

5. CONCLUSIONS

Territorial systems can be used as operational entities in the analysis of the relationships between the anthropic process and the process of consuming and degradation of primary eco-energies. Trans-scale analyses emphasize the possibility of correlatively interpreting the two processes, both at macro- and micro- territorial level. In the first case, the influence of the urbanisation process upon the degradation of primary eco-energies is relevant, and in the second case the influence of the process of anthropic process in a rural territorial system, situated in a fragile environment, represented by sub-carpathian environment is relevant, too.

The results obtained by the unfolding of the research in the two case studies confirm the hypothesis according to which by anthropic processes the quantity of primary eco-energies permanently diminishes, directly by consuming and indirectly by the facilitation of the processes of natural degradation. Their capacity of recovery is impossible in the strongly anthropised areas, respectively in large urban concentrations, and very difficult in fragile natural areas, inclusively after the diminishing of anthropic pressure.

At the same time, the information regarding the levels of consuming and degradation of primary eco-energies can be useful in the process of resources management, generated by interactions which functioned in historical or geological times. The results confirm the necessity of individualising some indicators which would take into account the ecological components, as well as the components of human existence and of the processes which integrate them (Plummer and Armitage, 2007). We consider that an efficient territorial management, on long and ultra-long term, where the respect for environment dominates all the categories of territorial actors (Ianoş et al., 2009), needs such qualitative assessments of the relationship between the anthropic process and the conservation of primary eco-energies, especially in the conditions of the global climatic changes.

6. AKNOWLEDGEMENTS

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REFERENCES

Bertrand, G., 1968. *Paysage et géographie physique globale. Esquisse méthodologique.* Revue Géographique des Pyrenées et du Sud-Ouest, 39, 3, 249-272.

Botnariuc, N., 1999. *Evolution of the overindividual biological systems*. Printing House of University of Bucharest, Bucharest, Romania (in Romanian), 216.

Braghină, C., Peptenatu, D., Constantinescu, S., Pintilii, R.D. & Drăghici, C., 2010. *The pressure exerted on the natural environment in the open pit exploitation areas in Oltenia.* Carpathian Journal of Earth and Environmental Sciences, 5, 1, 33-40.

Bunce, M., Mee, L., Rodwell, L.D. & Gibb, R., 2009. *Collapse and revovery in a remote small island – A tale of adaptive cycles or downward spirals?*. Global Environmental Change, 19, 213-226.

Cowen, D.J., 1988. *GIS versus CAD versus DBMS: What Are the Differences?*. Photogrammetric Engineering and Remote Sensing 54, 1551-1555.

Cumming, G.S. & Collier, J., 2005. *Change and Identity in Complex Systems*, Ecology and Society ,10, 1, 29.

Diaconu, D.C., 2005. *Water ressources of the Buzău River.* Universitary Printing House, Bucharest, Romania (in Romanian), 238.

Doxiadis, C.A., 1968. *Ekistiks: an Introduction to the Science of Human Settlements,* Hutchinson, London, 527.

Gotts, N.M., 2007. *Resilience, Panarchy, and World-Systems Analysis,* Ecology and Society. 12, 1, 24.

Holling C. S. & **Gunderson, L.H.,** 2002. *Resilience and adaptative cycles.* in: Gunderson, L.H., Hollings, C.S. (Eds.), Panarchy: understanding transformations in human and natural systems, Island Press, Washington D.C., 25-63.

Holling C. S., 2004. *From complex regions to complex worlds*, Ecology and Society, 9, 1, 11

Ianoş, I., 2000. *Territorial systems. A geographical approach*, Editura Tehnică, Bucharest, Technical Printing House, Bucharest, Romania (in Romanian), 197.

Ianoş, I., 2004. *Urban dynamic. Town and the Romanian urban system, as case studies.* Technical Printing House, Bucharest, Romania (in Romanian), 214.

Ianoş, I., Peptenatu, D. & Zamfir, D., 2009. *Respect for environment and sustainable development.* Carpathian Journal of Earth and Environmental Sciences, 4,1, 81–93.

Iorgulescu, B., 1892. *Geographical, statistical, and hystorical dictionnary of Buzău county*. I.V. SOCEC, Bucharest, Romania (in Romanian), 569.

Petrişor, A. I. & **Sârbu C. N.,** 2010. *Dynamic of geodiversity and eco-diversity in territorial systems*. Journal of Urban and Regional Analysis 2, 1, 61-70.

Petrişor A.I., Ianoş, I. & Tălângă, C., 2010. *Land cover and use changes focused on the urbanization processes in Romania.* Environmental Engineering and Management Journal, 9, 6, 765-771.

Pickett, S.T.A. & Cadenosso, M.L., 2002. *The ecosystem as multidimensional concept: meaning, model and metaphor*. Ecosystems, 5, 1-10.

Plummer, R. & Armitage, D., 2007. *A resielience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world*. Ecological Economics, 61, 62-74.

Sârbu C. N., 2006. *Housing in Romania: a framework approach, o abordare-cadru*. Printing House of University of Architecture and Planning „Ion Mincu" from Bucharest, Romania (in Romanian), 138.

Stoica, I.V., 2008. *The populationn's evolution by numbers in the hydrographic basin of Sărăţel (The Buzău Subcarpathians) in the interval 1966-2002,* Annals Geographical Series, tome VIII-IX, Editura Transversal, Bucharest, Transversal Printing House, 177-183

Vădineanu, A., 1998. *Sustainable development, Vol. I. Theoretical basis of sustainable development*. Printing House of University of Bucharest, Bucharest, Romania (in Romanian), 248.

Vădineanu, A., **Vădineanu, R.S. & Negrei C.,** 2004. *Development management: An ecosystemic approach*. Ars Docendi, Bucharest, Romania (in Romanian), 394.

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